

At a meeting of the Edinburgh Mathematical Society on March 14, the following resolutions in regard to the teaching of elementary mathematics were agreed to:—(1) That the primary object in teaching elementary mathematics is to afford a mental training to the pupil. The commercial, technical or professional applications of the subject are of secondary importance in general education. (2) That there should be no undue haste to begin the study of the calculus with a view to its practical applications. (3) That pupils should not be encouraged in the unscientific practice of placing dependence on rules or formulæ which they do not understand. (4) That, in teaching any branch of mathematics, concrete illustrations and verifications including experimental, graphical and other methods should, wherever practicable, accompany theory. (5) That in examinations particular methods of solution or demonstration should not, as a rule, be demanded, *e.g.*, the use of algebra should not be prohibited in answering questions in arithmetic or geometry. (6) That there should not be imposed upon schools in any branch of mathematics a syllabus which does more than indicate the order in which the main divisions of a subject are to be taught.

DR. D. C. GILMAN'S reminiscences of the foundation and early days of the Johns Hopkins University, given in the current number of *Scribner's Magazine*, contain several interesting particulars concerning men connected with it. Johns Hopkins left his fortune to be divided between a university and a hospital, the two to be united in the promotion of medical science. As the capital for the university was thus provided by a single individual, there were no bodies to interfere with its plans, and no public or treasury to conciliate. Given the idea and the funds, all that had to be done was to produce the plan of an institution which should aim at having national influence, and should take to Baltimore, as teachers and students, the ablest minds that could be attracted there. Rowland was an assistant instructor in the Rensselaer Polytechnic Institute when Dr. Gilman heard of him from General Michie, and the following conversation occurred:—"What has he done?" I said. "He has lately published an article in the *Philosophical Magazine*," was his reply, "which shows great ability. If you want a young man you had better talk with him." "Why did he publish it in London," said I, "and not in the *American Journal*?" "Because it was turned down by the American editors," he said, "and the writer at once forwarded it to Prof. Clerk Maxwell, who sent it to the English periodical." When Dr. Gilman had seen Rowland and reported upon his rare powers to the trustees in Baltimore they said at once, "Engage that young man and take him with you to Europe, where he may follow the leaders in his science and be ready for a professorship." This was done; and the result is well known. Huxley gave the inaugural address, but he had to deliver it from memory, as he could not read the fimsies with which the reporters to whom he had dictated the lecture on the previous day had provided him. After this opening without music, prayer or other benediction came the storm of indignation from the religious papers. Referring to the opening, a Presbyterian minister wrote to a friend:—"It was bad enough to invite Huxley. It were better to have asked God to be present. It would have been absurd to ask them both. I am sorry Gilman began with Huxley. But it is possible yet to redeem the University from the stain of such a beginning." It took some years for the prejudice to wear away, but eventually the idea of an undenominational university controlled by laymen was accepted as reasonable, and Johns Hopkins' foundations became renowned as places of freedom and progress.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 30.—"The Distribution of Magnetism as Affected by Induced Currents in an Iron Cylinder when Rotated in a Magnetic Field." By Ernest Wilson, Professor of Electrical Engineering, King's College, London. Communicated by Sir W. H. Preece, F.R.S.

One object of this research was to investigate the effect which induced currents have upon the distribution of magnetism in an iron cylinder when rotated about its longitudinal axis in a magnetic field, the direction of which was normally at right angles to the axis of rotation. The variables dealt with were the total flux of magnetism between the poles of the magnet, and the speed of rotation of the cylinder. By threading

insulated copper conductors through holes drilled in a plane containing the longitudinal axis, E.M.F.'s due to the rate of change of induction at different depths have been observed, and therefrom the intensity of induction has been found. The cylinder had a diameter of 25.4 cms., and its length was 25.4 cms. It was rotated by aid of a worm and worm wheel. Periodic times of 360, 180, 90, 45 and 22.5 seconds have been dealt with, and the normal induction density *B* in the cylinder has been varied from about 170 to 21,000 C.G.S. units per sq. cm.

With small magnetic force, and a periodic time of 45 seconds, the value of *B* at the centre of the cylinder is important as compared with its value at the surface, and the phase-displacement between the two is relatively small. With intermediate magnetic force, corresponding to high average permeability in the iron, the value of *B* at the centre became relatively small, accompanied by considerable phase-displacement. In fact, with 22.5 seconds periodic time, *B* at the centre was totally reversed in sign with regard to *B* at the surface, or the lag was 180°. With large magnetic force, *B* at the centre again became important, and the phase-displacement was again small. With a periodic time of 360 seconds, the disturbances above described still existed, but they were small. Similar effects to the above were observed in the case of an iron cylinder subjected to alternating magnetic force.

The conclusion was that with an alternating magnetic force applied axially to a cylinder of given diameter, the effects were more severe than in the same cylinder (of length equal to diameter) when rotated in a magnetic field as above described at the same frequency, and for corresponding values in the surface induction density. The results of these experiments were applied to similar cylinders of different dimensions by an application of the law of squares. The effects of induced currents in the armature of a certain class of induction motor were dealt with. It is shown that plates of iron 0.1 cm. thick experience no serious deviation from uniform distribution when rotated in a magnetic field, the direction of which was in the plane of the plate, at frequencies lower than about 180. Referring to Lord Kelvin's computation that the earth's magnetism is travelling round the earth in the direction of the sun with a periodic time relatively to the earth of 960 years, it is pointed out that in a cylinder similar in all respects to the one experimented upon, but having a diameter equal to that of the earth, a periodic time of 960 years would produce similar magnetic and electric events as would be observed in the above cylinder if it could be rotated with a periodic time nearly two million times as fast as the fastest speed in these experiments. On the other hand, with a cylinder 0.0000001 cm. diameter, 7×10^{14} revolutions per second would be required to produce the disturbances observed in these experiments.

March 6.—"The Differential Equations of Fresnel's Polarisation-vector, with an Extension to the Case of Active Media." By James Walker, M.A. Communicated by Prof. Clifton, F.R.S.

In many problems of optics we require the differential equations that the polarisation-vector has to satisfy, and the surface conditions that subsist at the interface of different media. These may be deduced from the principle of interference combined with the experimental laws of the propagation of light, without making any assumption respecting the character of the ether and the nature of the luminous vibrations. In crystalline media, Fresnel's theorem of the ellipsoid of polarisation affords the required relations between the wave-velocity and the directions of the wave-normal and of the polarisation-vector; in the case of active media, extensions of this theorem lead to similar equations giving the wave-velocity in terms of the direction-cosines of the wave-normal and the complex direction-cosines of the vector of a stream of elliptically polarised light. The differential equations are then deduced by applying the principle of interference. The surface conditions are obtained by assuming that the transition between two media takes place by a rapid continuous change of their properties and that the differential equations hold within the region of variation.

Royal Astronomical Society, March 14.—Dr. J. W. L. Glaisher, president, in the chair.—The secretary read a paper by Dr. Mitchell, of New York, on the flash spectrum at the Sumatra eclipse of May, 1901. Mr. Fowler gave reasons for doubting the correctness of Dr. Mitchell's view that the flash spectrum represents the upper portion of the layer of gas which, by absorption, gives the Fraunhofer lines.—A paper by Prof. Barnard on Nova Cygni, 1876, was partly read.—Mr. Maw presented a series of double star measures made by him in the

years 1899-1901.—The Astronomer Royal presented a paper on new variable stars found at the Royal Observatory during the measurement of plates for the Astrographic Catalogue, and also a series of measures of double stars made at Greenwich with the 28-inch refractor. Prof. Turner described an instrument for rapidly comparing two star plates of the same region, and Mr. Lewis spoke upon the orbit of δ Equulei.—Mr. Maunder gave an account of a paper from the Royal Observatory on the mean areas, &c., of sun-spots in the year 1901, and referred to the apparent connection between the large sun-spot of May 1901 and the disturbed portion of the corona as shown on the eclipse photographs.—Mr. Dyson gave a summary of a paper from the Royal Observatory on the parallax and proper motion of Nova Persei.—Mr. H. C. Plummer partly read a paper on the images formed by a parabolic mirror.—Mr. Whittaker read a paper on periodic orbits in the restricted problem of three bodies, being an extension of the paper read at the January meeting. The problem considered was that of finding the motion of a small planet under the attraction of the sun and a large planet, the latter being supposed to move in a purely circular orbit. Two theorems were communicated in the paper, the first giving a criterion for the existence of periodic orbits and the second being concerned with the value of an integral taken over the orbit.—A note by Mr. Fourcade was read, on Prof. Turner's recent paper on photographic surveying.

Mathematical Society, March 13.—Major P. A. MacMahon, F.R.S., vice-president, and subsequently Lieut.-Col. A. Cunningham, R.E., in the chair.—The Rev. J. Cullen read a paper on the solutions of a system of linear congruences. The object of the paper is to give a graphical process for obtaining the solutions of a system of linear congruences under a given limit; and the scope of the paper consists in establishing and explaining four simple rules to be employed in applications of the process; the process yields new results in the resolution of high numbers, having factors of unknown form, into sums of squares.—Mr. G. H. Hardy communicated a paper on the theory of Cauchy's principal values. This paper is the third of a series concerned with the interpretation, and the use in analysis, of such divergent definite integrals as have in Cauchy's sense a principal value; it deals in particular with the possibility of differentiation and integration under the sign of the principal value, and gives sufficient criteria for the validity of the interchange of order of the limiting operations involved; the theory is illustrated by numerous examples of the calculation of definite integrals by processes which had not previously been proved to be valid.—Mr. R. Hargreaves read a paper on algebraic relations between zonal harmonics of different orders. The coefficients in any sequence equation connecting zonal harmonics are rational functions of the orders of the harmonics, and these functions also are connected by sequence equations; the latter equations are developed systematically.—Dr. F. S. Macaulay made a preliminary communication of some results in the theory of elimination. He showed how to express the resultant of any number of homogeneous equations in any number of variables as a quotient of two determinants.—The following paper was communicated from the chair: Mr. J. Buchanan, on quadrature formulæ. The formulæ are obtained by the use of methods of interpolation based upon central differences.

Entomological Society, March 5.—The Rev. Canon Fowler, president, in the chair.—Mr. L. B. Prout exhibited, on behalf of Mr. J. P. Mutch, *Vanessa (Eugonia) polychloros*, L., a ♀ bred by Mr. H. Baker from pupa from Stowmarket, Suffolk, the ground-colour much darkened and the black markings somewhat enlarged; *Chrysophanus phlaeas*, L., an aberration (captured in the Isle of Wight, August, 1901) much suffused with dark colour, especially at outer margin and on hindwings, only a very small patch of the red colour remaining at the inner angle of the latter; *Agrotis puta*, Hb., a perfectly halved gynandromorphous example, and *Noctua sobrina*, Gn., an aberrant specimen with white antennæ and a somewhat hoary appearance on the forewings, taken in East Aberdeenshire, August, 1900.—Mr. A. Baco exhibited a series of *Malacosoma castrensis* and a series of *M. neustria* for comparison with a hybrid brood, resulting from a pairing between a male *neustria* and a female *castrensis*. This was the first time any exhibition of experiments of the kind had been made before the Society by British investigators, though Mr. Merrifield had shown a number of crosses bred by Herr Standfuss. The sexes, as exhibited, were very clearly distinguishable, and there was not much tendency to gynandromorphism, though

of sixty or seventy specimens almost every ♀ showed some signs of ♂ coloration.—Mr. O. E. Janson exhibited a pair of *Stephanocrates dohertyi*, Jord., a Goliath beetle discovered by the late W. Doherty in the highlands of British East Africa.—Dr. T. A. Chapman exhibited cocoons of a Limacodid moth from La Plata, with empty pupa-cases of a dipterous parasite of the genus *Systropus*. The resemblance between the two pupa cases is, however, not merely of appearance, but functional also. The moth-pupa, *i.e.* the moth itself inside the pupa-case, almost certainly by inflating itself with air, to secure greater size and a stiffened epiderm as a basis of muscular action, exerts an end-to-end pressure within the cocoon, and so forces off a lid. The *Systropus* breaks off a similar lid, no doubt by similar end-to-end pressure to that exerted by the moth, Diptera having highly developed the habit of inflating themselves with air, at emergence from the pupa. This pupa also has a beak very like that of the Limacodid, but even stronger and sharper.—Mr. J. E. Collin, in further illustration of Dr. Chapman's remarks, exhibited specimens of *Systropus*, sp. ? from Buenos Ayres, parasitic on a Bombycid Lepidopteron (*Limacodes*?). This, he said, was possibly the same as Dr. Chapman would have reared from his cocoons. The species was apparently undescribed, but most allied to *S. brasiliensis*, Meg.—Prof. E. B. Poulton, F.R.S., read a paper entitled "Five years' observations and experiments (1897-1901) on the bionomics of South African insects, chiefly directed to the investigation of mimicry and warning colours," by Guy A. K. Marshall, with appendices containing descriptions of new species, by W. L. Distant and Colonel C. T. Bingham.—Mr. Malcolm Burr contributed a monograph of the genus *Acrida* with notes of some allied genera and descriptions of new species.—Dr. D. Sharp, F.R.S., contributed three papers by Mr. R. C. L. Perkins, respectively entitled: (a) Notes on Hawaiian wasps, with descriptions of new species"; (b) "Four new species and a new genus of parasitic Hymenoptera (Ichneumonidae) from the Hawaiian Islands"; and (c) "On the generic characters of Hawaiian Crabronidae: four new genera characterised."

Geological Society, March 12.—Sir Archibald Geikie, F.R.S., vice-president, in the chair.—The crystalline limestones of Ceylon, by Mr. Ananda K. Coomara-Swamy. The crystalline rocks of Ceylon may be divided into three series: (1) The older gneisses; (2) the crystalline limestones; (3) the granulites (charnockite series)—pyroxene-granulite, leptynite, &c. A local subdivision of this series is the Point de Galle group—wollastonite-scapolite-gneisses, &c. The crystalline limestones of Ceylon are intimately associated with the banded pyroxene and acid granulites (charnockite series). They form bands with outcrops from a few feet to more than a quarter of a mile in width, interbedded with the granulites. The limestones themselves have a banded structure (foliation) parallel to that of the granulites and to the boundaries. Although the relation of the granulites to the limestones is on the whole intrusive, the two rocks in their present condition are essentially contemporaneous, and seem alike to have consolidated from a molten magma. The calcite occurring in the granulites near the contact has all the appearance of an original mineral. The foliation of the limestones is regarded as a sort of flow-structure, and corresponds with that of the granulites to which it is always parallel. That the foliation does not result from the action of earth-movements on a solid rock is shown by this, that the very minerals whose variable distribution is one of its chief causes have certainly not been affected by deforming earth-movements, nor are they such as to have been produced by these; moreover, in this respect a distinction cannot be made between the limestones and granulites, which would necessarily have suffered alike had they been subjected to deforming strains since the consolidation of the latter. The original nature of the limestones is less evident; they may have been sedimentary or tuffaceous, and, if so, subsequently softened and metamorphosed; or possibly *ab initio* truly igneous rocks, and related to the charnockite-magma. Reasons for and against these views are given. The relations between the crystalline limestones and nepheline-syenites of Alnö have suggested to Prof. Högbom that perhaps the limestone may have been a product of the nepheline-syenite magma there. The author feels sure that the crystalline limestones of Ceylon have not arisen by the alteration of the basic limel-silicates of the pyroxene-granulites.—On Proterozoic gastropoda which have been referred to Murchisonia and Pleurotomaria, with descriptions of new subgenera and species, by Miss

Jane Donald. Many of the Palæozoic shells referred to Murchisonia do not agree with the type, and there are at least two separate groups distinguished by the outer lip. The typical group has a slit, the other merely a sinus. From the material at present available, in the British Isles as well as in America and the Baltic provinces, elongated forms with a sinus precede those with a slit. So far, no light is thrown on the question as to whether Murchisonia and Pleurotomaria were derived from the same stock, nor has the author yet met with any specimens showing a transition from sinus to slit.

PARIS.

Academy of Sciences, March 17.—M. Bouquet de la Grye in the chair.—Some remarks on the periods of double integrals and the transformation of algebraic surfaces, by M. Émile Picard.—Studies on vegetable earth, by M. Th. Schloesing. The earth is separated by a process of levigation into fractions, which are analysed separately. The most striking fact obtained by this method of working is the rapid change in the proportions of iron and phosphoric acid in the fractions. The ratio of iron to phosphorus, however, remained practically constant.—On the culture of the fodder beet, by M. P. P. Dehérain. The method of cultivation of the beet, which aims only at producing roots of the largest size, is faulty, as analyses of such roots show that they contain an undue amount of water and nitrates. By planting out so that smaller beets are obtained, it was found that although the gross weight per hectare was somewhat less in the latter case, the weight of dry material was greater and the loss of nitrates was reduced.—M. Vermoloff was elected a correspondent in the Section of Rural Economy in the place of the late Sir J. B. Lawes.—On regular groups of finite order, by M. Léon Autonne.—On the theory of algebraic functions of finite order, by M. Beppo Levi.—On the conservation of refractive energy in mixtures of alcohol and water, by M. A. Leduc. The refractive indices of mixtures of alcohol and water can be calculated from the refractive indices of the two constituents within the limits of experimental error, allowance being made for the contraction which takes place on mixing the two liquids.—On the mobility of the ions in gases, by M. P. Langevin.—Research on a unit for measuring the force of penetration of the X-rays and for their quantity, by M. G. Contremoulins. The principle adopted for these measurements is the comparison of the intensity of illumination of a fluorescent platinumcyanide screen with a screen artificially illuminated with a light of known intensity.—The heat of reaction between bodies in the solid and gaseous state, by M. Ponsot.—The heats of solution of solid and liquid ammonia taken at about -75°C. , and on the latent heat of fusion of solid ammonia, by M. G. Massol. The method adopted was to dissolve first liquid ammonia and then solid ammonia, both as near -75°C. as possible, in water in a calorimeter; the latent heat of fusion was thus obtained as the difference between these two results. The value thus found for the latent heat of fusion for a gram-molecule of solid ammonia was -1.838 , approximating to that of water, -1.43 .—The volumetric estimation of thallium, by M. V. Thomas. The author has modified the iodometric method of Feit, in such a manner as to avoid the conversion into the sulphate. Test analyses are given showing the accuracy of the method as modified.—Acid and basic sulphates of neodidymium and praseodidymium, by M. Camille Matignon. Four new sulphates are indicated, their properties determined, and their thermochemical relations examined.—A method for the alkalimetric estimation of disodium-methylarsenate or arrhenal, by M. A. Astruc. The method suggested is based on the fact that in the presence of rosolic acid one molecule of this substance requires one molecule of a monobasic acid for neutralisation.—On some derivatives of arabinose, by M. G. Chavanne. The exact conditions are given for the production of a pure substance in the interaction of arabinose with acetyl chloride and bromide. The preparation and properties of the phenylhydrazone of arabinose are also described.—On the supposed binaphthalene-glycol, by M. R. Fosse. It is shown that the body described as binaphthalene-glycol is in reality dinaphthoxanthidrol, and that the derivatives of the supposed glycol are similarly constituted.—On the pseudo-acids, by M. P. Th. Muller. For a true acid the difference of the molecular refractions of the acid and its sodium salt should be equal to the difference of the molecular refractions of sodium hydrate and water, and for a large number of acids of the order of acetic this has been found to be the case, the value of this constant difference being about 1.55 . Any marked variation from this value would indicate that the constitution

of the acid was different from its neutral salt. This the author has found to be the case for a certain number of isonitroso-compounds of the fatty series.—On the classification of the Cercomonadines, by M. Louis Léger.—The use of organic arsenic and phosphorus compounds in the treatment of tuberculosis, by M. A. Mouneyrat. Sodium methylarsenate taken alone has no effect in preventing the excessive elimination of phosphorus in tuberculosis. But by the administration of this salt, together with an easily assimilable phosphorus compound, such as nucleic acid, the desired result was obtained. A marked improvement was noticed in less than a month, with gain in weight, increase in appetite, disappearance of the nocturnal sweats, and of fever. At the end of a month or six weeks the sputum became normal, losing its purulent character and, in the majority of cases, with the disappearance of the tubercle bacillus.—The action of temperature on the mineral absorption in etiolated plants, by M. G. André. It was found that the quantity of ash in 100 parts of the dried material is always greater in the normal plant than in the plant etiolated at 15°C. ; the reverse was the case in an etiolated plant growing at 30°C. , the difference being entirely represented by silica.—On the assimilation of carbon by a green alga, by M. P. G. Charpentier.—A bacteriological study of the *massif* of Mont Blanc, by M. Jean Binot. The number of germs in the air at the summit of Mont Blanc is extremely small, varying between four and eleven per cubic metre, and increases as the valley is approached. The ice, snow and water on the mountain were made the subject of a separate study. A virulent pyocyanic bacillus was isolated from the ice at the summit, and an exceedingly pure water taken near the Montanvert showed twelve colonies of a virulent *Bacterium coli* per cc.—Experimental researches on the mental life of a xiphopage, by MM. N. Vaschide and H. Piéron.

DIARY OF SOCIETIES.

WEDNESDAY, APRIL 2.

SOCIETY OF PUBLIC ANALYSTS, at 8.

THURSDAY, APRIL 3.

RÖNTGEN SOCIETY, at 8.30.—X-ray Diagnosis of Renal Calculus: Dr. Ch. Leonard.

LINNEAN SOCIETY, at 8.—On the Composite Flora of Africa: W. Spencer Moore.—A Halonial Branch of *Lepidophloeus fuliginosus*: Prof. F. E. Weiss.

FRIDAY, APRIL 4.

GEOLOGISTS' ASSOCIATION, at 8.—Klondike, its Geology and Mining: Prof. H. A. Miers.

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